

Before the
Federal Communications Commission
Washington, D.C. 20554

In the Matter of
Amendment of Part 15 of the Commission's
Rules To Establish Regulations for Tank Level
Probing Radars in the Frequency Band
77-81 GHz
and
Amendment of Part 15 of the Commission's
Rules To Establish Regulations for Level Probing
Radars and Tank Level Probing Radars in the
Frequency Bands 5.925-7.250 GHz,
24.05-29.00 GHz and 75-85 GHz
ET Docket No. 10-23

FURTHER NOTICE OF PROPOSED RULE MAKING

Adopted: March 26, 2012

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By the Commission:

I. INTRODUCTION

1. In this Further Notice of Proposed Rule Making (FNPRM), we are expanding the scope of the above-referenced proceeding to propose a set of technical rules for the operation of unlicensed level probing radars (LPR) in several frequency bands. LPR devices are low-power radars that measure the level (relative height) of various substances in man-made or natural containments. In open-air environments, LPR devices may be used to measure levels of materials such as coal piles or water basin levels. An LPR device also may be installed inside an enclosure, e.g., a tank made of materials such as steel or fiberglass and commonly referred to as a tank level probing radar (TLPR) that could be filled with liquids or granulates. In the Notice of Proposed Rule Making and Order (Notice and Order) in this proceeding, we proposed rules applicable only to TLPR devices for operation in the 77-81 GHz band inside steel and concrete tanks, as that was the use requested by the initial proponents. During the pendency of the rulemaking proceeding, but outside this proceeding,

1 See Amendment of Part 15 of the Commission's Rules To Establish Regulations for Tank Level Probing Radars in the Frequency Band 77-81 GHz, Notice of Proposed Rulemaking and Order (Notice and Order), ET Docket Nos. 10-23, 06-216 and 07-96, 25 FCC Rcd 601 (2010).

2 In the Notice and Order, we also requested comment on whether to allow TLPR operation in the broader 75-85 GHz band. Notice and Order, 25 FCC Rcd. 601, 606-607 (2010) at para. 14.

we received waiver requests<sup>3</sup> and other inquiries regarding outdoor use on additional frequencies under existing Part 15 rules for unlicensed devices.<sup>4</sup> To address the apparent need for a comprehensive and consistent approach to LPR devices, we are proposing in this FNPRM rules that would apply to the operation of LPR devices installed in both open-air environments and inside storage tanks in the following frequency bands: 5.925-7.250 GHz, 24.05-29.00 GHz, and 75-85 GHz.

2. LPR devices can provide accurate and reliable target resolution to identify water levels in rivers and dams or critical levels of materials such as fuel, sewer-treated waste, and high risk substances, reducing overflow and spillage and minimizing exposure of maintenance personnel in the case of high risk materials.<sup>5</sup> We are proposing a set of rules that would be applicable to LPR devices (including TLPR devices) that would allow the expanded development of a variety of radar level-measuring products that will benefit the public and industry and improve the accuracy and reliability of these measuring tools beyond that which is permitted under our current Part 15 rules. To the extent practicable, these proposals would also harmonize our technical rules for LPR devices with similar European standards in an effort to improve the competitiveness of U.S. manufacturers in the global economy. We believe that, with appropriate rules, LPR devices can operate on an unlicensed basis in the proposed frequency bands without causing harmful interference to authorized services.

## II. BACKGROUND

3. LPR devices are downward-looking low-power transmitters that are used to measure the level (relative height) of various materials. They can operate either inside a tank (or similar enclosure) or in an open-air environment, *e.g.*, mounted under a bridge to measure water levels in a basin/river or under a roof structure to measure mounds of granulates such as coal. An LPR device is typically mounted at the top of an enclosure or on a support rail and emits radio frequency signals from an antenna aimed downwards at the surface of the substance below. The device measures or calculates the time delay between the transmitted signal and the return echo reflected off the surface of the material being measured to determine the material's level. Current technology typically uses either traditional pulsed modulation techniques or frequency-modulated continuous waves (FMCW) producing bandwidths greater than or equal to 50 megahertz. With a pulsed-modulated LPR, short duration pulses are transmitted toward the target, and the target distance is calculated using the pulse transit time. With an FMCW-modulated LPR, a continuous frequency-modulated signal is transmitted, and the frequency difference caused by the time delay between transmission and reception indicates the target distance. To conserve power, LPR devices operate with a low duty cycle: 20 percent or below for FMCW and much lower for pulsed LPR emissions. LPR devices do not establish communications networks, and there is minimal likelihood that two or more devices will emit simultaneously within close proximity of one another.

4. Most LPR devices on the U.S. market<sup>6</sup> currently operate on an unlicensed basis at 6 GHz,

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<sup>3</sup> See *e.g.*, *Ohmart/VEGA Corporation Request for Waiver of Section 15.252 to Permit the Marketing of Level Probing Radars in the 26 GHz Band*, ET Docket No. 10-27.

<sup>4</sup> 47 C.F.R. § 15.209. This section allows any type of unlicensed intentional radiator to operate in any frequency band, other than "restricted" bands identified in 47 C.F.R. § 15.205(a) of the rules, as long as it complies with the general radiated emission limit.

<sup>5</sup> Over-filling of plant equipment can damage machinery, threaten workers' safety, and cause environmental damage. Under-filling of equipment such as rock crushers can result in machinery running empty, leading to severe product damage and collateral worker injury.

<sup>6</sup> Siemens, Krohne, SAAB Rosemount Tank Radar AB, etc., are FMCW radars manufacturers. Ohmart/VEGA, Endress+Hauser, Inc., Enraf B.V., etc., are pulsed radars manufacturers. See, *e.g.*, Ohmart/VEGA model VEGAPULS 68 operating at 26 GHz, at <http://www.ohmartvega.com/bulksolids/31425-US-050617.pdf>, model VEGAPULS 66 operating at 6.3 GHz at <http://www.ohmartvega.com/downloads/PI/EN/31486-EN.pdf>; Milltronics

24 GHz, or 26 GHz under the general emission limits in Section 15.209 of the Commission's rules.<sup>7</sup> LPR users select an LPR based on its frequency bands of operation according to the type of substance being measured and the installation. For example, LPR devices operating in the 6 GHz frequency range are often used for applications where the substance to be measured has high contamination or severe foaming characteristics; because the dust or foam is made up of relatively large particles, these substances tend to scatter a higher frequency signal, and therefore a relatively low frequency is necessary to penetrate to the surface below. LPR devices operating in the 24-26 GHz frequency range can accommodate a wide variety of applications but are less effective on foam, condensation, contamination, or turbulent materials.

5. LPR devices operating at even higher frequencies, *i.e.*, above 30 GHz in the "millimeter wave" spectrum, could be very effective in applications where access is limited because they can employ smaller antennas.<sup>8</sup> Smaller antennas can accommodate existing small connection flanges more easily, enabling the radar to be installed in tighter spaces and smaller enclosures than is possible with existing technology. In addition, antennas that operate at higher frequencies would likely employ narrower beamwidths.<sup>9</sup> Narrower beams would enable avoidance of extraneous objects located in proximity to the desired target, such as agitators, filling pipes, or adjacent loading machinery, thereby resulting in improved resolution and more precise measurements.<sup>10</sup>

6. On January 14, 2010, the Commission adopted the *Notice and Order* in this proceeding in response to: (1) a Petition for Rulemaking from Siemens Milltronics Process Instruments Inc. (Siemens)<sup>11</sup> requesting that the Commission amend its rules to allow TLPR devices to operate in the "restricted" 77-81 GHz frequency band inside steel or concrete tank enclosures;<sup>12</sup> (2) a concurrent request for waiver, also by Siemens, of Section 15.205(a) to allow TLPR operation in the 78-79 GHz frequency band, subject to certain conditions;<sup>13</sup> and (3) a similar request for waiver by Ohmart/VEGA Corporation (Ohmart/VEGA)<sup>14</sup> to allow TLPR operation in the 77-81 GHz band.<sup>15</sup> The *Notice and Order* proposed to

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model IQ300 operating at 6.3 GHz at [http://www.lesman.com/unleashd/catalog/sensors/sensors\\_iqradar300.html](http://www.lesman.com/unleashd/catalog/sensors/sensors_iqradar300.html); Siemens model Sitrans LR400 operating at 24 GHz at <https://pia.khe.siemens.com/index4936.htm>; Endress+Hauser Micropilot FMR240 operating at 26 GHz at <http://www.pci-instruments.com/html/micropilot.html>.

<sup>7</sup> See fn. 4, *supra*.

<sup>8</sup> The term "millimeter wave" arises from the fact that the wavelength of radio signals operating on frequencies between 30 GHz and 300 GHz ranges from 10 millimeters to 1 millimeter, respectively.

<sup>9</sup> "Beamwidth" refers to the angle between the half-power points (*i.e.*, the -3 dB points) of the main lobe of an antenna, when referenced to the peak effective radiated power of the main lobe. Beamwidth is usually expressed in degrees.

<sup>10</sup> A radar operating at 5 GHz with a 4-inch antenna would illuminate an area with a diameter of 14.4 feet (6.1 meters) in a storage tank 20 feet high, whereas the same radar operating at 24 GHz would illuminate an area with a diameter of only 3.6 feet (1.2 meters). A larger beamwidth would more likely illuminate and pick up echoes from objects other than the desired target, causing errors and introducing inaccurate readings, thus manufacturers argue that it is necessary to operate with as small a beamwidth as possible.

<sup>11</sup> Siemens Petition for Rulemaking (Siemens Petition), ET Docket 06-216 (filed Nov. 3, 2006).

<sup>12</sup> "Restricted" bands are frequency bands where unlicensed devices are not allowed to intentionally radiate energy and may only emit spurious emissions. These bands are usually used by licensed services for safety-of-life communications or for radio operations that use very low received levels, *e.g.*, satellite downlinks or by critical and sensitive federal services. The restricted bands are listed in 47 C.F.R. § 15.205(a).

<sup>13</sup> Siemens Request for Waiver and Petition for Rulemaking, ET Docket 06-216 (filed Nov. 3, 2006). *See also* Public Notice, DA 06-2475 (rel. Dec. 6, 2006).

<sup>14</sup> Ohmart/VEGA Waiver Request, ET Docket 07-96 (filed April 30, 2007). *See also* Public Notice, DA 07-2518 (rel. Jun. 12, 2007).

modify Part 15 of the rules to allow the 77-81 GHz frequency band to be used on an unlicensed basis for the operation of LPR equipment installed inside closed storage tanks made of metal, concrete, or other material with similar attenuating characteristics and also sought comment on whether to allow TLPR operation on an unlicensed basis in the 75-85 GHz band.<sup>16</sup> The *Notice and Order* also sought comment on whether the Commission should allow installation of TLPR devices in tanks made of materials with a lower attenuation coefficient than steel/concrete, including open-air installations, and requested input on additional measures to ensure that TLPR devices installed in such enclosures comply with the radiated emissions limit outside the tank.<sup>17</sup> No comments were received in opposition to the specific proposals set forth in the *Notice and Order*, but no comments were received regarding open-air installations or other containers. The *Order* granted waivers of the restriction on spurious emissions in the 77-81 GHz band set forth in Section 15.205(a) to Siemens, Ohmart/VEGA, and any other responsible party that meets the specified waiver conditions, to permit TLPR devices to be installed inside tanks with high attenuation characteristics, *e.g.*, steel or concrete, pending the conclusion of the concurrently initiated rulemaking.

7. To date, the Commission has authorized LPR devices primarily for use in tanks upon demonstration of compliance with Section 15.209 of the rules, which specifies an average EIRP limit of -41.3 dBm for operations above 960 MHz.<sup>18</sup> In addition, Section 15.35(b) of the rules sets a peak limit at 20 dB above the average limit, *e.g.*, a peak EIRP limit of -21.3 dBm.<sup>19</sup> For pulsed signals, it may be necessary to take into account the limitations of the measurement instrumentation to determine the total peak power level, through the use of a pulse desensitization correction factor (PDCF), which is an adjustment factor that must be added to the indicated value of a pulsed emission on a spectrum analyzer when the emission bandwidth of the pulse exceeds the resolution bandwidth of the analyzer.<sup>20</sup> Therefore, pulsed LPR devices often must reduce their peak power output to comply with the peak emission limit in Section 15.209 and thus may sacrifice the necessary precision and accuracy required in many applications. LPR devices using other modulation techniques, *e.g.*, FMCW, also need wider bandwidth in certain frequency ranges to achieve the necessary measurement precision.

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<sup>15</sup> Authorized operations in the 77-81 GHz band currently include radio astronomy (Federal and non-Federal at 76-85 GHz), radiolocation (Federal and non-Federal at 76-77.5 GHz and 78-81 GHz), space research (Federal and non-Federal at 74-84 GHz), amateur (non-Federal at 76-81 GHz), and amateur satellite (non-Federal at 77-81 GHz). 47 C.F.R. § 2.106. These services typically employ highly directional antennas because propagation loss is significant over short distances at these frequencies.

<sup>16</sup> *Notice and Order*, 25 FCC Rcd. 601, 606-607 (2010) at para. 14.

<sup>17</sup> *Id.* at 609, para. 20.

<sup>18</sup> 47 C.F.R. § 15.209(a). Emission measurements must be performed such that the maximum emissions are found by rotating the equipment under test (EUT), including pointing the EUT antenna directly at the measurement antenna.

<sup>19</sup> 47 C.F.R. § 15.35(b). Devices operating under Section 15.209 of the rules are required to comply with a total peak limit in their entire operating frequency band. This standard was implemented when Part 15 devices primarily employed narrowband emissions. See discussion in *Revision of Part 15 Rules regarding Ultra-Wideband Systems* in ET Docket 98-153, , *Second Report and Order and Second Memorandum Opinion and Order*, (Wide-Band Order) 19 FCC Rcd. 24558, 24565-24567 (2004) at paras. 16 and 21.

<sup>20</sup> *Id.* Depending on a number of factors (*e.g.*, resolution bandwidth, pulse width, etc.), the spectrum analyzer may not always display the true peak value of the measured emission. This effect, called “pulse desensitization,” relates to the capabilities of the measuring instrument, *i.e.*, the spectrum analyzer does not have sufficient bandwidth to measure all of the energy in the pulsed signal. See Public Notice, *OET Clarifies Equipment Authorization Policy for Measurement of Broadband Emissions*, DA 04-3946 (rel. Dec. 17, 2004). The application of the PDCF is a necessary step in emission measurements to capture and report the true energy in pulsed signals if a total peak value is required.

8. Because LPR devices need higher power and wider bandwidth than that permitted under the current rules to fully achieve the potential of radio frequency (RF) level-measuring technology, LPR manufacturers also have considered whether they could operate under other Part 15 rules applicable to wide-band devices, *i.e.*, those employing a bandwidth greater than 10 megahertz.<sup>21</sup> Those rules allow higher peak-to-average power ratios than are permitted by Section 15.35(b) and specify a power limit in terms of power spectral density rather than total peak power, thus eliminating the need to apply a PDCF.<sup>22</sup> Section 15.250 permits operation in the 5.925-7.250 GHz band but prohibits “fixed outdoor infrastructure.”<sup>23</sup> Section 15.252 only permits operation of radars mounted in terrestrial transportation vehicles in the 16.2-17.7 GHz and 23.12-29.0 GHz bands. Because of these various frequency and operational restrictions, LPR devices currently cannot be certified to operate under either of these alternative wide-band rules without grant of a waiver.

9. On January 26, 2010, the Commission placed on public notice<sup>24</sup> a request for waiver of Section 15.252(a) of the Commission’s rules filed by Ohmart/VEGA to permit certification of LPR devices installed at fixed locations at outdoor sites as well as inside storage tanks in the 24.6-27 GHz frequency band.<sup>25</sup> On January 3, 2011, the Commission also received a request for waiver of the frequency band restrictions of Section 15.250 from Sutron Corporation to operate its water level probing radar in the 5.460-7.250 GHz frequency band with fixed outdoor infrastructure. Because these waiver requests raise issues that are, in part, similar to those raised in this FNPRM, we are holding these two requests in abeyance pending final action in this rulemaking proceeding.

10. Over the past few years as the Commission has considered various issues related to LPR operations in the United States, similar regulatory activities have taken place in Europe regarding the use of RF devices in level measuring applications and certain issues regarding emission limits and measurement techniques. In 2006, the European Telecommunications Standards Institute (ETSI) adopted a technical standard for TLPR devices.<sup>26</sup> In 2010, the Electronic Communications Committee (ECC) within the European Conference of Postal and Telecommunications Administrations (CEPT) published an ECC Report of a study of the co-existence of LPR devices, including those used in open-air environments, with various authorized services in the 6-8.5 GHz, 24.05-26.5 GHz, 57-64 GHz, and 75-85 GHz and adjacent frequency bands.<sup>27</sup> This ECC Report ultimately served as the basis for an ETSI

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<sup>21</sup> Section 15.252 requires the use of a bandwidth of at least 10 megahertz, and Section 15.250 requires the use of a bandwidth of at least 50 megahertz. 47 C.F.R. §§ 15.250 and 15.252.

<sup>22</sup> Wide-band devices are required to comply with a peak limit based on power density in a specific bandwidth, not a total peak limit over their entire operating frequency range. Both Sections 15.250 and 15.252 permit a maximum peak emission limit of 0 dBm as measured in a 50-megahertz resolution bandwidth. 47 C.F.R. §§ 15.250 and 15.252.

<sup>23</sup> 47 C.F.R. § 15.250(c). This rule prohibits fixed outdoor infrastructure to avoid the establishment of wide-area networks of devices seeking to operate under this section. *See* Wide-Band Order, 19 FCC Rcd. 24558, 24571 (2004) at para. 27.

<sup>24</sup> *See* Public Notice DA 10-128 (rel. Jan. 26, 2010).

<sup>25</sup> Section 15.252(a) permits the use of field disturbance sensors within the frequency bands 16.2-17.7 GHz and 23.12-29.0 GHz but requires them to be mounted in terrestrial transportation vehicles, whereas Ohmart/VEGA’s LPR devices would only be installed at fixed locations. *See Ohmart/VEGA Corporation Request for Waiver of Section 15.252 to Permit the Marketing of Level Probing Radars in the 26 GHz Band*, ET Docket No. 10-27.

<sup>26</sup> *See* ETSI TLPR Technical Standard. *See also, Notice and Order*, 25 FCC Rcd. 601, 602 (2010) at para. 3.

<sup>27</sup> *See* ECC Report 139.

technical standard for LPR devices.<sup>28</sup>

11. To determine the maximum allowable radiated emission limits for LPR devices operating in each authorized frequency band, the ECC studied the interference potential of an LPR by taking into account reflected emissions within a hemispherical boundary around the LPR device. The ECC assumed a worst-case material reflectivity coefficient and limited these reflected emissions to -41.3 dBm at a distance of 3 meters from the source, which is the same limit as the general emission limit in Section 15.209 of the Commission's rules.<sup>29</sup> Based on previous work within ETSI,<sup>30</sup> the ECC determined the main-beam emission level that correlates to a reflected emission level of -41.3 dBm. The ECC also determined that main-beam emissions must be measured with the LPR transmit and measurement (receive) antennas "boresighted" to produce the maximum realizable antenna coupling.<sup>31</sup> As compared to the Part 15 rules, the main-beam emission limits derived from this ECC modeling effort would allow an LPR device to operate at higher peak levels than Part 15 currently permits<sup>32</sup> but would continue to provide the same level of interference protection to authorized services as any other Part 15 device, provided that the LPR antenna always maintains a downward position and utilizes a relatively narrow beamwidth.<sup>33</sup> The ECC determined that because the LPR is always pointing downward, direct emissions from the LPR antenna are focused toward the substance being measured, therefore only residual emissions reflected from this material or from the ground surface would be seen by a potential victim receiver operating within an authorized radio service located above (e.g., a satellite receiver) or horizontally relative to an LPR transmitting source. The ECC also determined that a main-beam emission limit would simplify compliance measurements of LPR emissions, because emissions from the LPR would be measured

<sup>28</sup> See ETSI LPR Technical Standard. ETSI permits operation of LPR devices in the bands proposed by the ECC Report. *Id.*, at p. 24.

<sup>29</sup> See ECC Report 139 at p. 19-20. The ECC found that the worst-case reflection losses for calm water with a 0 degree angle of incidence are 1.9 dB, and up to 13 dB for solid granular materials such as dry sand, at angles of incidence 0-33 degrees. *Id.*, at Annex 2, p. 63. From test results obtained in practical measurements to verify theoretical considerations, ECC concludes that "the results of lab measurements showed that for ... fine dry sand (measured under conditions of its natural surface coarseness, yet formed in a flat bed as opposed to conical shape that would be more suitable for natural conditions), the reflection loss was around 14 dB and is little dependent on the angle of incidence." *Id.*

<sup>30</sup> See *Electromagnetic compatibility and Radio spectrum Matters (ERM); System Reference Document; Short Range Devices (SRD); Equipment for Detecting Movement using Ultra-Wide Band (UWB) Radar Sensing Technology; Level Probing Radar (LPR)-sensor equipment operating in the frequency bands 6 GHz to 8,5 GHz, 24,05 GHz to 26,5 GHz, 57 GHz to 64 GHz, 75 GHz to 85 GHz*, European Telecommunications Standards Institute (ETSI) Technical Report (TR) 102 601 V1.1.1 (2007-12), (ETSI LPR Technical Report).

<sup>31</sup> Antenna boresight is the axis of maximum gain (maximum radiated power) of a directional antenna.

<sup>32</sup> Sections 15.209 and 15.35(b) impose a total peak limit of -21.3 dBm for operation of Part 15 devices above 960 MHz. 47 C.F.R. §§ 15.209 and 15.35(b). Sections 15.250 and 15.252 impose a peak limit of 0 dBm in a 50-megahertz bandwidth for Part 15 devices operating in the 5.925-7.250 GHz, 16.2-17.7 GHz and 23.12-29.00 GHz frequency bands. 47 C.F.R. §§ 15.250 and 15.252. The ECC LPR peak emission limits are +7 dBm for LPR devices operating in the 5.925-7.250 GHz band, +26 dBm for LPR devices operating in the 24.05-29.00 GHz band and +34 dBm for LPR devices operating in the 75-85 GHz band, as measured in a 50-megahertz resolution bandwidth. The limits differ for each frequency band because the modeling took into account the frequency-dependent propagation loss characteristics in each band.

<sup>33</sup> The Part 15 rules specify an average emission limit of -41.3 dBm from Part 15 devices operating above 960 MHz, as the minimum protection to authorized services. The ECC modeling provides for an equivalent main-beam average emission limit of -33 dBm in the 5.925-7.250 GHz band, -14 dBm for LPR devices operating in the 24.05-29.00 GHz band, and -3 dBm for LPR devices operating in the 75-85 GHz band, as measured in a 1-megahertz resolution bandwidth. The limits again differ for each frequency band because the modeling took into account the frequency-dependent propagation loss characteristics in each band.

directly in the main beam of the antenna where maximum emissions are found, thus avoiding the measurement of reflected emissions that can be highly variable due to the variable site-related factors involved with *in situ* testing.<sup>34</sup>

### III. DISCUSSION

12. In this FNPRM, we propose a set of rules that would be applicable to LPR devices used in any RF level-measuring application, whether in an open-air environment or inside an enclosure, to address the needs for a comprehensive and consistent approach to LPR devices. These proposals are intended to allow for the introduction of more diverse applications of LPRs in several frequency bands and improve the accuracy and reliability of these level-measuring tools beyond what is permitted under our current Part 15 rules. We also believe that the proposed rules will help to simplify equipment development and certification of LPR devices as well as provide a simplified method for measuring the radiated emissions from these devices.

13. As mentioned above, to date, the Commission has authorized LPR devices primarily for use in tanks upon demonstration of compliance with Section 15.209 of the rules, which specifies an average EIRP limit of -41.3 dBm for operations above 960 MHz. In addition, these devices have also been required to demonstrate that they comply with Section 15.35(b) of the rules, which sets a peak limit at 20 dB above the average limit, *e.g.*, a peak EIRP limit of -21.3 dBm. Pulsed LPR devices often must reduce their peak power output in order to comply with this peak emission limit and thus may sacrifice the necessary precision and accuracy required by many applications. LPR devices using other modulation techniques, *e.g.*, FMCW, also need wider bandwidth in certain frequency ranges to achieve the necessary measurement precision. LPR devices need higher power and wider bandwidth than permitted under Section 15.209 of the rules to fully achieve the potential of RF level-measuring technology. In addition, the Part 15 rules for similar wide-band devices such as Section 15.250 or 15.252 contain frequency and operational restrictions which preclude the certification of LPR devices absent a waiver.

14. In addition, as discussed below, the traditional practice of measuring radiated emissions at a 3-meter horizontal distance from the radiating source while varying the measurement antenna height from 1 meter to 4 meters may not yield repeatable results for LPR emissions when measured *in situ*. The difficulties in measuring reflected emissions from LPR devices that are pointed downward is one reason why ETSI/ECC evaluated and ultimately adopted a comparable main-beam emission limit for LPR devices.<sup>35</sup>

15. In expanding the scope of this rulemaking proceeding, we are responding to an industry-wide need to employ wider bandwidth and higher power to implement more diverse applications in RF level-measuring while maintaining or improving accuracy and reliability. Specifically, we propose to amend Part 15 to provide a set of new rules to govern specifically the operation of LPR devices installed both in open-air environments and inside storage tanks (TLPR applications) in the following frequency bands: 5.925-7.250 GHz, 24.05-29.00 GHz, and 75-85 GHz.<sup>36</sup> To permit LPR operation in the 75-85 GHz band, we also propose to modify existing Section 15.205 of the rules to remove the prohibition on intentional emissions in this band. We further propose to treat LPR and TLPR devices the same with respect to emission limits and frequency bands of operation without any additional installation limitations. That is, a level measuring radar that complies with our proposed rules would be able to be

<sup>34</sup> ECC Report 139 at p. 2 and p. 11.

<sup>35</sup> See discussion on Compliance Measurement in paragraph 33, *infra*.

<sup>36</sup> LPR devices are already permitted to operate in the 5.925-7.250 GHz and 24.05-29.00 GHz bands under Section 15.209 of the rules, as are many other types of unlicensed devices, and LPR devices may continue to be authorized under this rule for use in these or other bands.

used in any application, whether outdoors in the open or inside any type of enclosure. Accordingly, the proposals for emission limits in this FNPRM would supersede the emission limit proposals for TLPR devices in the *Notice and Order*.

16. We are proposing emission limits for the main-beam emissions which are based on the ETSI LPR Technical Standard and take into account the fact that there may be no additional attenuation provided by a tank enclosure, as discussed in detail below. The proposed limits would allow the main-beam emissions from LPRs to be higher in power than is allowed under the general emission limits in Section 15.209. However, the levels of reflected emissions are not expected to exceed those general emission limits, and therefore no increased potential for interference is expected. We also propose to require that all spurious/unwanted emission limits from LPRs not exceed the general emission limits in Section 15.209 when measured in the main beam of a device's transmit antenna; the measurement procedure would also utilize elevation and azimuth measurement scans to determine the location at which these unwanted emissions are maximized.<sup>37</sup> To further protect authorized services operating in the same and adjacent frequency bands, we propose to: (1) require the LPR antenna to be dedicated or integrated as part of the transmitter and professionally installed in a downward position; (2) limit installations of LPR devices to fixed locations; and (3) prohibit hand-held applications of LPR and the marketing of LPR devices to residential consumers.<sup>38</sup>

17. We base these proposals on the various waiver and informal rule interpretation requests we have received, and the emission limits adopted in Europe for LPR devices. Although our proposals would generally harmonize our rules with the European LPR regulations with respect to the limits for fundamental emissions, they also would address the specific spectrum needs and restrictions in the U.S.<sup>39</sup> The proposed rules are set forth in Appendix B.

18. *Frequency Bands of Operation.* We propose to allow LPR operation under the new technical rules in the following frequency bands: 5.925-7.250 GHz, 24.05-29.00 GHz, and 75-85 GHz.<sup>40</sup> In the *Notice and Order*, we proposed rules for TLPR devices in the 77-81 GHz band; in this FNPRM we propose to expand the frequency bands for LPR operation under the new rules for both in-tank and in open-air environments to include the 75-85 GHz band. We seek comment on our proposals for LPR operation in each of the frequency bands discussed below.

19. We believe, for the reasons stated below, that allowing LPR devices to operate under the

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<sup>37</sup> It is possible that the source of the worst-case unwanted emissions from a device may be its control circuitry and/or RF leakage from its enclosure, rather than the device's transmitter circuitry and antenna.

<sup>38</sup> A "dedicated" antenna is an integrated antenna that is part of the main transmitter unit and cannot be replaced with another antenna of different gain characteristics.

<sup>39</sup> ETSI permits TLPR and LPR devices to operate in several frequency bands that we do not include in our proposals in this FNPRM. For example, ETSI permits operation of TLPR devices inside tanks made of steel or concrete or other material of comparable RF attenuation in the 4.5-7 GHz and 8.5-10.6 GHz bands and LPR (including TLPR) devices in the 57-64 GHz band. See ETSI TLPR Technical Standard at p. 20; ETSI LPR Technical Standard at p. 24. We take a different approach by proposing that each authorized band be available for both LPR and TLPR applications. This will allow manufacturers to take advantage of economies of scale by marketing the same LPR device for a variety of RF level-measuring applications.

<sup>40</sup> We note that these frequencies are slightly different than those adopted by ETSI and also that in the U.S. there are several "restricted" bands, as identified in Section 15.205(a) of our rules, 47 C.F.R. § 15.205(a), in some portions of the ETSI LPR lower frequency range. For instance, in the ETSI 6-8.5 GHz frequency range, in this country there are restricted frequencies in the 7.25-7.75 GHz and 8.025-8.5 GHz bands, where the Federal Government operates critical and sensitive services, such as fixed microwave, fixed satellite, and meteorological satellite services. 47 C.F.R. § 2.106. Parties seeking use of these bands should request a waiver.

technical rules we propose herein will not increase the likelihood of harmful interference to incumbent authorized radiofrequency operations. LPR devices are typically installed at fixed industrial sites, such as quarries, paper mills, and ore refineries, or at facilities adjacent to bodies of water, such as dams, storm water lift stations, and sewage treatment plants, all of which are generally well away from residences. We also propose requiring LPR devices to utilize narrow beamwidth transmit antennas focused in a downward orientation. This will serve to minimize the likelihood of interference to any incumbent spectrum operations within proximity of a fixed LPR system. Finally, as discussed below, the emission limits proposed herein for LPR devices will ensure that incumbent operations are afforded similar protection as currently provided by the existing emission limits in Section 15.209 of the rules.

20. Currently, unlicensed wide-band transmitter operation within the 5.925-7.250 GHz band is permitted under Section 15.250 of our rules. In this band, licensed uses include non-Federal fixed, fixed satellite, and mobile services from 5.925 MHz to 7.125 MHz; and Federal fixed and space research services (deep space & Earth-to-space) from 7.125 MHz to 7.250 MHz.<sup>41</sup> Part 15 transmitters operating in this band are prohibited from being used in toys or operating on board an aircraft or satellite. They cannot utilize a fixed outdoor infrastructure, including outdoor-mounted transmit antennas, to establish a wide area communications network.<sup>42</sup> We believe that our proposal to adopt rules to permit LPR operation in the 5.925-7.250 GHz band, including permitting limited fixed outdoor installations, is consistent with the intent underlying the usage restrictions in Section 15.250. In this regard, LPRs will be single, *i.e.*, relatively isolated, transmitters whose individual operations outdoors will not result in a dense deployment of transmitters.

21. Unlicensed wide-band operation in the 23.12-29.0 GHz band is permitted under Section 15.252 of our rules.<sup>43</sup> This band is shared between Federal and non-Federal services. Authorized licensed operations include radiolocation, EESS (active), amateur, fixed, inter-satellite, radionavigation, radiolocation satellite (Earth-to-space), fixed satellite (Earth-to-space), mobile, standard frequency and time signal satellite (Earth-to-space), space research (space-to-Earth), and EESS (space-to-Earth) services. Currently, unlicensed transmitters operating in this band must be mounted on vehicles and cannot be used in aviation applications. To provide expanded flexibility for optimizing LPR applications and to enhance global marketing opportunities by more closely harmonizing with ETSI in this frequency range, we propose to permit LPR operation in the 24.05-29.00 GHz band.<sup>44</sup> The proposed frequency band is wider than that which ETSI has adopted; however, we believe that the risk of interference to incumbent authorized services from LPR devices will be no greater than it is from existing Part 15 radars currently operating in this band because LPR devices operate in a fixed downward-looking position.

22. Apart from a few exceptions, all spectrum above 38.6 GHz, including the 75-85 GHz band,<sup>45</sup> is designated by footnote as a “restricted band” in Section 15.205 of the rules.<sup>46</sup> Consequently, unless expressly permitted by rule or waiver, unlicensed devices are not allowed to intentionally radiate energy

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<sup>41</sup> 47 C.F.R. § 2.106.

<sup>42</sup> See n.23, *supra*.

<sup>43</sup> 47 C.F.R. § 15.252.

<sup>44</sup> ETSI only allows LPR operation in the 24.05-26.5 GHz band, presumably due to other European incumbent services at frequencies higher than 26.5 GHz.

<sup>45</sup> The Commission opened the 76-77 GHz band to unlicensed vehicular radars in 1995 in *Amendment of Parts 2, 15 and 97 of the Commission’s Rules to Permit Use of Radio Frequencies Above 40 GHz for New Radio Applications, First Report and Order and Second Notice of Proposed Rule Making*, ET Docket 94-124, 11 FCC Rcd 4481 (1996).

<sup>46</sup> 47 C.F.R. § 15.205(a).

into a restricted band in order to protect sensitive radio services from harmful interference.<sup>47</sup> The Commission has permitted unlicensed operation within specific frequency bands above 38.6 GHz, *e.g.*, 46.7-46.9 GHz, 57-64 GHz, 76-77 GHz, and 92-95 GHz.<sup>48</sup>

23. The 75-85 GHz band is shared between Federal and non-Federal services. Authorized operations in this band currently include radio astronomy, fixed/mobile/fixed satellite, mobile satellite, broadcast and broadcast satellite, radiolocation, space research (space-to-Earth), amateur and amateur satellite services.<sup>49</sup> In addition, unlicensed vehicular radars are currently permitted to operate in the 76-77 GHz band.<sup>50</sup> The services in this band typically employ highly directional antennas to overcome the relatively higher propagation loss that occurs at these frequencies.<sup>51</sup> In the *Notice and Order*, the Commission proposed to allow TLPR operation in the 77-81 GHz band and also sought comment on whether it should permit TLPR devices to operate in the broader 75-85 GHz band.<sup>52</sup> No objections were received from incumbent service operators with respect to TLPR operation in the 75-85 GHz band in response to the *Notice and Order*.<sup>53</sup> We believe that an extension of the frequency range to allow LPR operation in the 75-85 GHz band will not adversely affect incumbent authorized users, because this band is currently sparsely used<sup>54</sup> and the propagation losses are significant at these frequencies, making harmful interference unlikely beyond a short distance from the LPR device.<sup>55</sup> We seek comment on this proposal.

24. *Radiated Emission Limits.* We propose to adopt radiated emission limits for LPR devices operating in each of the proposed frequency bands as set forth in the table below. These limits are

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<sup>47</sup> See *Revision of the Rules Regarding Operation of Radio Frequency Devices Without an Individual License, First Report and Order*, GEN Docket 87-389, 4 FCC Rcd 3493 (1989). See also, 47 C.F.R. 15.205(a).

<sup>48</sup> See 47 C.F.R. §§ 15.253, 15.255 and 15.257. The 57-64 GHz band is open to most types of unlicensed operations, while the 46.7-46.9 GHz and 76-77 GHz bands are limited to unlicensed vehicular radars and operation within the 92-95 GHz band is limited to indoor applications.

<sup>49</sup> 47 C.F.R. § 2.106.

<sup>50</sup> 47 C.F.R. § 15.253. We note that the Commission has proposed to modify Sections 15.35 and 15.253 of the rules to enable enhanced vehicular radar technologies in the 76-77 GHz band. See *Amendment of Sections 15.35 and 15.253 of the Commission's Rules Regarding Operation of Radar Systems in the 76-77 GHz Band, and Amendment of Section 15.253 of the Commission's Rules to Permit Fixed Use of Radar in the 76-77 GHz Band*, ET Docket Nos. 11-90 and 10-28, *Notice of Proposed Rule Making*, 26 FCC Rcd. 8107 (2011).

<sup>51</sup> There is approximately 58 dB of free space attenuation at 3 meters for a 6 GHz signal and 80 dB of free space attenuation at 3 meters for an 80 GHz signal. Free space path loss (FSPL) is calculated according to the formula  $FSPL = 20 \log F(\text{GHz}) + 20 \log D(\text{m}) + 32.5$ , with frequency F in GHz and distance D in meters.

<sup>52</sup> *Notice and Order*, 25 FCC Rcd. 601, 606-607 (2010) at para. 14.

<sup>53</sup> We noted in the *Notice and Order* that Krohne America, an LPR manufacturer, states that the wider bandwidth specified by ETSI is necessary for TLPR devices to accurately process and resolve the various reflected images within tanks of different sizes and construction. *Notice and Order*, 25 FCC Rcd. 601, 606 (2010) at para. 13.

<sup>54</sup> We note that the Commission is seeking comment on the best way to enable the use of foreign object detection (FOD) radar equipment in the 78-81 GHz band and has granted a waiver of Section 90.103(b) of the rules to Trex Enterprises Corporation. In that proceeding, we seek comment on whether there is any potential for interference from 78-81 GHz band radiolocation systems to other services in the 78-81 GHz band, including TLPR devices. See *Amendment of the Commission's Rules to Permit Radiolocation Operations in the 78-81 GHz Band, and Request by the Trex Enterprises Corporation for Waiver of Section 90.103(b) of the Commission's Rules*, WT Docket No. 11-202, *Notice of Proposed Rule Making and Order*, 77 FR 1661 (Jan 11, 2012) at paras. 10-11 & 15-18.

<sup>55</sup> The wavelength of an LPR device operating at 75 GHz is 4 millimeters, and the free space path loss at this frequency is approximately 79.5 dB at a distance of 3 meters (*i.e.*, 750 wavelengths away) from the transmitter. See fn. 51, *supra*.

consistent with those adopted by ETSI.<sup>56</sup> As discussed above, ETSI derived its emission limits for main-beam emissions by mathematically correlating the reflected emissions from an LPR with the existing Part 15 average emission limit for devices operating above 960 MHz.<sup>57</sup> The proposed emission limits therefore would maintain the existing level of interference protection to incumbent radio services. We also believe that harmonization of our limits with the ETSI limits is desirable because it could serve to expand global marketing opportunities for U.S. manufacturers.

Frequency Band (GHz)	Average Emission Limit (EIRP in dBm/MHz) as measured boresight (Note 2)	Peak Emission Limit (EIRP in dBm measured in 50 MHz) as measured boresight (Note 2)	Equivalent Average Reflected Emissions if measured <i>in situ</i> (EIRP in dBm/MHz) (Note 3)
5.925-7.250	-33	+7	-55
24.05-29.00	-14	+26	-41.3
75-85	-3	+34	-41.3

- Notes:**
1. Minimum bandwidth at the -10 dB points is 50 megahertz.
  2. All emission limits defined herein are based on boresight measurements (*i.e.*, measurements performed within the main beam of an LPR antenna).
  3. Equivalent reflected emissions include antenna back-lobe and side-lobe emissions and worst-case reflections from material being measured.

25. As previously discussed, ETSI/ECC based these limits on the results of mathematical modeling which was supported by measurement data.<sup>58</sup> ETSI/ECC's modeling effort shows that if the LPR complies with the main-beam (boresight) emission limits specified in the second and third columns of the table above, any reflected emissions, including antenna back-lobe or side-lobe emissions and worst-case reflections from the target material, will also comply with the existing average emission limit specified in Section 15.209 for devices operating above 960 MHz, shown in the table's fourth column.<sup>59</sup> The main-beam emission limits vary with frequency band because the mathematical models accounted for the frequency-dependent propagation loss characteristics associated with each band.<sup>60</sup> We seek comment

<sup>56</sup> See ETSI LPR Technical Standard at p. 26 and 29 and ECC Technical Report 139 at p.3.

<sup>57</sup> ETSI/ECC calculated through mathematical modeling the amount of main-beam emissions of a downward-pointing antenna that would limit reflected emissions to 500 $\mu$ V/m at a distance of 3 meters from the source, which is equivalent to an EIRP level of -41.3 dBm (this is the same as the Part 15 existing average emission limit.) Its mathematical modeling took into account reflected emissions in the vertical plane above the LPR device—as in the case of an open-air LPR installation over water—as well as reflected emissions in the horizontal plane around the LPR device with a worst-case scenario of material reflectivity coefficient. ETSI/ECC determined that because the LPR is always pointing downward, only reflected emissions would be seen by a potential victim receiver of an authorized radio service located above (*e.g.*, a satellite receiver) or horizontally relative to the LPR transmitting source.

<sup>58</sup> ECC Report 139 at Annex 4.

<sup>59</sup> We note that the ETSI equivalent average reflected emission level in the 5.925-7.250 GHz band (used to derive the average and peak main-beam limits) is more stringent than the -41.3 dBm limit in Section 15.209; however, we still propose to harmonize with Europe on the derived main-beam limits for this frequency range. We note also that in our rules, the limits at these frequencies for some UWB devices are also more stringent than Section 15.209. See *e.g.*, 47 C.F.R. §§ 15.510(c)(4) and 15.515(d).

on these proposed emission limits.

26. We believe that the proposed LPR emission limits as measured in the main beam of the LPR antenna will adequately protect against harmful interference to incumbent authorized services in any of the proposed frequency bands, based on several factors. First, LPR devices will be required to utilize downward-focused narrow-beam transmit antennas, which are also needed to optimize level-measuring performance. Therefore, the only LPR emissions likely to be incident on an incumbent receiver within proximity will be reflected from the target material and thus significantly attenuated. Second, the proposed LPR emission limits are consistent with the results expected from application of the existing limits in radiated *in situ* measurements and therefore will maintain the existing level of protection afforded to incumbent authorized services.<sup>61</sup> Third, as the operating frequency increases, the propagation path loss also increases as a result of the increased attenuating effects on radio waves from intervening objects and atmospheric conditions. Finally, as discussed below, we are proposing certain operational conditions that would further reduce the likelihood of harmful interference to authorized services. Accordingly, we conclude that LPR devices will be able to share spectrum with incumbent authorized services in the proposed bands at the proposed emission limits. We seek comment on this tentative conclusion.

27. In the *Notice and Order*, for TLPR devices operating in the 77-81 GHz band in tanks with very high RF attenuation characteristics, *e.g.*, steel or concrete, we proposed an emission limit of +43 dBm on the transmitter's peak EIRP and +23 dBm on the transmitter's average EIRP levels for fundamental emissions when measured in a laboratory setting, *i.e.*, not installed in a tank. We also proposed to limit the radiated emissions from the TLPR device, when installed in representative tanks of each material type for testing *in situ*, to the general radiated emission limits for intentional radiators in Section 15.209(a) of our rules when measured outside of the TLPR tank enclosure in any direction.<sup>62</sup> We stated that emissions outside of the tank will likely be minimal when considering the tank enclosure's attenuation coefficient in addition to the absorption characteristics of the target material (liquid or solid), and thus, any reflected signal will be mostly contained within the tank.<sup>63</sup> We also noted that *in situ* testing would require performance of compliance tests on a tank of each material type intended for use with the LPR at three representative installation sites (*e.g.*, a metallic tank at three representative installation sites, a concrete tank at three representative installation sites), which could prove quite burdensome to an applicant.<sup>64</sup>

28. We are now proposing to treat TLPR devices in the same manner as LPR devices with respect to both emission limits and frequency bands of operation. Thus, if an LPR complies with these proposed rules, it can be installed inside an enclosure or out in the open since the proposed emission limits do not assume any additional attenuation provided by a tank enclosure.<sup>65</sup> Although the emission

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<sup>60</sup> Higher frequencies have more associated propagation losses. For example, there are approximately 58 dB of free space path loss at 3 meters for a 6 GHz signal versus 80 dB for an 80 GHz signal.

<sup>61</sup> See 47 C.F.R. §§ 15.250(d)(1), 15.252(b)(1) & (2), 15.509(d), 15.510(d)(3), 15.511(c), 15.513(d), 15.515(d), 15.517(c), and 15.519(c).

<sup>62</sup> *Notice and Order*, 25 FCC Rcd. 601, 604 (2010) at para. 8. The general emission limit is 500 $\mu$ V/m as measured at 3 meters from the tank enclosure, which is equivalent to an EIRP level of -41.3 dBm.

<sup>63</sup> *Id.*, at 605, para. 11.

<sup>64</sup> *Id.*, at 609, para. 22.

<sup>65</sup> Further, the *Notice and Order* specifically proposed to limit the types of tanks to steel and concrete. Tank material selection depends on the type of substance to be measured, *e.g.*, acidic substances may corrode a steel tank but would not affect a plastic tank. For electromagnetic compatibility considerations, if a tank enclosure is made of a material that does not significantly attenuate the radar signal, unintentional emissions could escape through the

limits proposed herein are somewhat lower than the TLPR limits previously-proposed (e.g., +34 dBm peak EIRP vs. +43 dBm peak EIRP, respectively), we note that the proposed limits do not assume any tank enclosure attenuation. We believe that this will alleviate the burdens involved in performing *in situ* compliance testing. These proposals also will permit TLPR devices to be used with a variety of tank materials, potentially increasing the useful applications of the technology. Accordingly, we are proposing a definition for LPR devices that would encompass open-air and in-tank applications. We seek comment on these proposals.

29. *Antenna Beamwidth.* We note that the ECC recommendations are based on modeling results that assume the LPR antenna beamwidth is limited to less than 12 degrees for frequencies below 57 GHz and less than 8 degrees in the 75-85 GHz bands.<sup>66</sup> We note that maintaining a narrow antenna beamwidth is also a performance criterion for optimizing LPR operations because a narrower beam reduces false echoes from objects other than the desired target material. We propose to adopt these antenna beamwidth requirements and seek comment on this proposal.

30. *Antenna Side Lobe Gain.* In assessing compatibility between LPR devices and systems operating in other radio services, the ETSI/ECC modeling effort assumed a maximum side lobe antenna gain of -10 dBi for off-axis angles from the main beam of greater than 60 degrees.<sup>67</sup> In addition to the requirements for antenna beamwidth, we seek comment on the necessity of establishing limits on the gain of the antenna in the side lobe region and off-axis angle where the gain is to be defined.

31. *Automatic Power Control.* ECC also recommends the implementation of automatic power control (APC) with a dynamic range of 20 dB for LPRs. We note that as a consequence of our proposed emission limits, all reflected emissions from the LPR device will be kept at or below the Part 15.209 general emission limits. Thus, as tentatively concluded above, harmful interference to other spectrum users is not expected. Therefore, we do not propose to adopt APC requirements for LPR devices. Any party advocating a requirement for APC should provide technical analyses as to why the emission limit in Section 15.209 is not adequate.

32. *Compliance Measurement.* As stated above, a primary reason for ECC adoption of a main-beam emission limit for LPR devices is to reduce the difficulties associated with measuring reflected emissions from an LPR device *in situ*.<sup>68</sup> We also note, in concurrence with ETSI/ECC, that the current compliance practice of measuring reflected radiated emissions at a 3-meter horizontal distance from the radiating source while varying the measurement antenna height from 1 meter to 4 meters often does not yield repeatable results when LPR emissions are measured *in situ*. This is because the patterns of reflected emissions tend to vary and are therefore difficult to measure consistently, propagation losses in the higher frequency bands are significant, and it is not always practical to create a test bed that is representative of all of the substances that an LPR will measure, making it difficult to determine the worst-case reflectivity factor. In addition, the current measurement procedure does not consider any potential emissions that may radiate from the top of an LPR device. The limits proposed herein will

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tank's walls and the radar enclosure (mounting flange and flange gaskets, etc.) to increase the reflected emissions in the vertical and horizontal planes relative to the radar. Accordingly, an enclosure made of fiberglass or plastic would provide very little RF attenuation and would be equivalent, or nearly so, to the radar transmitter operating in an open-air environment. We also note that there is a growing trend towards using plastic or fiberglass tanks.

<sup>66</sup> ECC Report 139 at p. 3.

<sup>67</sup> The side lobes are smaller beams that are away from the main beam. These side lobes are usually radiation in undesired directions which can never be completely eliminated. The side lobe level (or side lobe ratio) is an important parameter used to characterize antenna radiation patterns.

<sup>68</sup> ECC Report 139 at p. 2.

account for such emissions that could be missed entirely when applying the existing *in situ* compliance measurement procedures. With a main-beam emission limit, emissions are to be evaluated with the measurement antenna pointed directly at the LPR antenna, and as long the LPR complies with this limit, its reflected emissions in any direction will generally not exceed the existing average emission limit in Section 15.209, thereby maintaining the same level of interference protection to incumbent authorized users. We tentatively conclude that the main-beam emission limit will facilitate representative, reliable, and repeatable emission measurements of the emissions from LPR devices. We seek comment on this tentative conclusion.

33. Based on our experience to date with compliance measurements of and the proposals herein for main-beam emission limits for LPR devices, we seek comment on the following compliance measurement procedures. The Commission's Office of Engineering and Technology may publish specific information on how to conduct compliance testing following these procedures, *e.g.*, by publication in a guidance document or as specified in the rules.<sup>69</sup>

- Radiated measurements of the fundamental emission bandwidth and power shall be made with maximum main beam coupling between the LPR and test antennas (boresight).
- Measurements of the unwanted emissions radiating from an LPR shall be made utilizing elevation and azimuth scans to determine the location at which the emissions are maximized.
- All emissions at and below 960 MHz shall be measured with a CISPR quasi-peak detector.
- The fundamental emission bandwidth measurement shall be made using a peak detector with a resolution bandwidth of 1 MHz and a video bandwidth of at least 3 MHz.
- The provisions in Sections 15.35(b) & (c) that limit the peak power to 20 dB above the average limit and require emissions to be averaged over a 100 millisecond period do not apply to devices operating under this section.
- Compliance measurements of frequency-agile LPR devices shall be performed with any related frequency sweep, step, or hop function activated.

34. *Operational and Marketing Restrictions.* We propose to adopt operational restrictions to require the antenna of an LPR device to be dedicated or integrated as part of the transmitter and professionally installed in a downward position; to limit installations of LPR devices to fixed locations; to prohibit hand-held applications of LPR devices; and to prohibit the marketing of LPR devices to residential consumers. We propose these restrictions to protect incumbent authorized services operating in the same and adjacent frequency bands from harmful interference. We seek comment on these proposals.

35. *Equipment Certification.* In the *Notice and Order*, we proposed to require that TLPR devices designed to operate in the 77-81 GHz band be approved under the Commission's certification procedures and that certification be performed by the Commission's Laboratory rather than by Telecommunications Certification Bodies (TCB).<sup>70</sup> We noted that because a standard test procedure for LPR devices had not yet been devised for use at these frequencies, this requirement would give the Commission time to

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<sup>69</sup> See 47 C.F.R. § 2.947.

<sup>70</sup> TCBS are accredited third-party product certification bodies authorized to issue a grant of certification for certain products in lieu of a traditional grant issued by the Commission. *Notice and Order*, 25 FCC Rcd. 601, 610 (2010) at para. 24. See also, 47 C.F.R. §§ 2.1031-2.1060.

develop appropriate measurement guidelines for devices intended for operation in this frequency band. We observe, however, that the new proposals made herein will facilitate the direct measurement of emissions within the main beam of the LPR antenna and are consistent with compliance measurement methodologies currently used with other types of unlicensed transmitters. We therefore propose to permit TCBs to certify LPR devices operating under these proposed rules. We seek further comment on this proposal.

36. We are aware that some approvals of TLPRs have already been granted under Section 15.209 of our rules. These devices may continue to operate under Section 15.209 if their worst-case radiated emissions continue to comply with the limits in these rules.<sup>71</sup> We recognize that a certified TLPR device could be approved to operate under other conditions, *e.g.*, outdoor installations in open-air environments, in an enclosure with low RF attenuation characteristics, or with higher power. To allow previously-certified devices to take advantage of the changes proposed in this FNPRM, we propose to allow the responsible party to file for a permissive change<sup>72</sup> request in accordance with the existing rules and practices, provided that: (1) the LPR device operates only within the frequency bands authorized by rules proposed herein; (2) measurement data taken in accordance with the measurement procedure proposed above is provided to demonstrate compliance with the new emission limits specified in these proposed rules; and (3) operational changes to the device are being implemented by software upgrade without any hardware change. We seek comment on this proposal.

37. *Cost Benefit Analysis.* We believe that the benefits of the proposed regulations for manufacturers and users outweigh any potential costs. LPR devices need higher power and wider bandwidth than that which is permitted under the existing Part 15 rules to fully achieve the potential of this measuring technology. Our proposed rules would provide a necessary remedy for these devices to operate at the power levels and in the appropriate frequency bands required to deliver the needed accuracy for diverse applications, thereby promoting the expanded development and use of this technology to the benefit of businesses, consumers, and the economy. The proposed higher power levels in the proposed frequency bands would further the development of better and improved level-measuring tools, but these

<sup>71</sup> In the case of TLPR devices operating under waiver, these devices may continue to do so under the terms of the waiver. *See, e.g.*, Krohne model BM702 operating at 8.5-9.9 GHz at [http://www.krohne.com/html/dlc/MA\\_BM702\\_e\\_72.pdf](http://www.krohne.com/html/dlc/MA_BM702_e_72.pdf). Krohne TLPR operation inside steel tanks in this band is pursuant to a waiver of the 9-9.2 GHz and 9.3-9.5 GHz restricted bands of Section 15.205(a) issued in 2001 by Bruce Franca, Acting Chief, Office of Engineering and Technology of the FCC, with concurrence of the National Telecommunication Information Administration (NTIA). *See* letter of September 5, 2001, from William Hatch of NTIA to Bruce Franca, Acting Chief, OET, FCC; *see also*, letter of October 26, 2001, from Bruce A. Franca to Fish & Richardson granting Krohne its waiver request, in *Revision of Part 15 regarding Ultra-Wideband Transmission Systems*, ET Docket 98-153, *First Report and Order*, 17 FCC Rcd. 7435, 7450 (2002) fn 81.

<sup>72</sup> 47 C.F.R. § 2.1043 defines three classes of permissive changes that may be made without obtaining a new grant of equipment authorization and labeling a device with a new FCC identification number. The three classes of permissive changes are: (1) Class I, which includes those modifications in the equipment that do not degrade the characteristics reported by the manufacturer and accepted by the Commission when certification is granted; (2) Class II, which includes those modifications that degrade the performance characteristics as reported to the Commission at the time of the initial certification; and (3) Class III, which includes modifications to the software of a software defined radio transmitter that change the frequency range, modulation type, or maximum output power (either radiated or conducted) outside the parameters previously approved or that change the circumstances under which the transmitter operates in accordance with Commission rules. 47 C.F.R. § 2.1043(b). No filing is required with the Commission or a TCB for a Class I permissive change. Class II and III permissive changes require an abbreviated filing with the Commission or a TCB and an acknowledgement that the changes are acceptable before the changed equipment can be marketed but do not require a complete application for certification or new FCC identification number. Class III permissive changes are not permitted on a device that has had a Class II permissive change. *See also*, Knowledge Data Base (KDB) No. 178919 at <https://apps.fcc.gov/oetcf/kdb/forms/FTSSearchResultPage.cfm?id=33013&switch=P>.

changes would not increase the potential for interference to authorized users beyond what is permitted under the current rules. In addition, the proposed rules will help to simplify equipment development and certification of LPR devices, as well as provide a simplified method for measuring the radiated emissions from these devices. We seek comment on this analysis and any additional benefits that may result from these proposed rules. Parties that oppose these proposed rules should cite specific harms that they believe would result from changing the rules.

#### IV. PROCEDURAL MATTERS

38. *Initial Regulatory Flexibility Analysis for the Further Notice of Proposed Rule Making.* As required by Section 603 of the Regulatory Flexibility Act, 5 U.S.C. § 603, the Commission has prepared an Initial Regulatory Flexibility Analysis (IRFA) of the possible significant economic impact on small entities of the proposals suggested in this document. The IRFA is set forth in Appendix A.

39. *Initial Paperwork Reduction Analysis.* The *Further Notice of Proposed Rule Making* does not contain proposed new or modified information collection requirements.

40. *Ex Parte Rules – Permit-But-Disclose Proceeding.* The proceeding that this *Further Notice of Proposed Rule Making* initiates shall be treated as a "permit-but-disclose" proceeding in accordance with the Commission's *ex parte* rules.<sup>73</sup> Persons making *ex parte* presentations must file a copy of any written presentation or a memorandum summarizing any oral presentation within two business days after the presentation (unless a different deadline applicable to the Sunshine period applies). Persons making oral *ex parte* presentations are reminded that memoranda summarizing the presentation must (1) list all persons attending or otherwise participating in the meeting at which the *ex parte* presentation was made, and (2) summarize all data presented and arguments made during the presentation. If the presentation consisted in whole or in part of the presentation of data or arguments already reflected in the presenter's written comments, memoranda or other filings in the proceeding, the presenter may provide citations to such data or arguments in his or her prior comments, memoranda, or other filings (specifying the relevant page and/or paragraph numbers where such data or arguments can be found) in lieu of summarizing them in the memorandum. Documents shown or given to Commission staff during *ex parte* meetings are deemed to be written *ex parte* presentations and must be filed consistent with rule 1.1206(b). In proceedings governed by rule 1.49(f) or for which the Commission has made available a method of electronic filing, written *ex parte* presentations and memoranda summarizing oral *ex parte* presentations, and all attachments thereto, must be filed through the electronic comment filing system available for that proceeding, and must be filed in their native format (e.g., .doc, .xml, .ppt, searchable .pdf). Participants in this proceeding should familiarize themselves with the Commission's *ex parte* rules.

41. *Comments.* Pursuant to sections 1.415 and 1.419 of the Commission's rules, 47 C.F.R. §§ 1.415, 1.419, interested parties may file comments and reply comments on or before the dates indicated on the first page of this document. Comments may be filed using the Commission's Electronic Comment Filing System (ECFS). See *Electronic Filing of Documents in Rulemaking Proceedings*, 63 FR 24121 (1998).

- Electronic Filers: Comments may be filed electronically using the Internet by accessing the ECFS: <http://fjallfoss.fcc.gov/ecfs2/>
- Paper Filers: Parties that choose to file by paper must file an original and one copy of each filing. If more than one docket or rulemaking number appears in the caption of this proceeding, filers must submit two additional copies for each additional docket or rulemaking number.

<sup>73</sup> 47 C.F.R. §§ 1.1200 *et seq.*

Filings can be sent by hand or messenger delivery, by commercial overnight courier, or by first-class or overnight U.S. Postal Service mail. All filings must be addressed to the Commission's Secretary, Office of the Secretary, Federal Communications Commission.

- All hand-delivered or messenger-delivered paper filings for the Commission's Secretary must be delivered to FCC Headquarters at 445 12<sup>th</sup> St., SW, Room TW-A325, Washington, DC 20554. The filing hours are 8:00 a.m. to 7:00 p.m. All hand deliveries must be held together with rubber bands or fasteners. Any envelopes must be disposed of before entering the building.
- Commercial overnight mail (other than U.S. Postal Service Express Mail and Priority Mail) must be sent to 9300 East Hampton Drive, Capitol Heights, MD 20743.
- U.S. Postal Service first-class, Express, and Priority mail must be addressed to 445 12<sup>th</sup> Street, SW, Washington DC 20554.

People with Disabilities: To request materials in accessible formats for people with disabilities (braille, large print, electronic files, audio format), send an e-mail to [fcc504@fcc.gov](mailto:fcc504@fcc.gov) or call the Consumer & Governmental Affairs Bureau at 202-418-0530 (voice), 202-418-0432 (tty).

#### V. ORDERING CLAUSES

42. IT IS ORDERED that pursuant to Sections 1, 4(i), 302, 303(e), 303(f), 303(g), and 303(r) of the Communications Act of 1934, as amended, 47 U.S.C. Sections 151, 154(i), 302, 303(e), 303(f), 303(g), and 303(r), this Further Notice of Proposed Rule Making IS ADOPTED.

43. IT IS FURTHER ORDERED that NOTICE IS HEREBY GIVEN of the proposed regulatory changes described in this Further Notice of Proposed Rulemaking, and that comment is sought on these proposals.

44. IT IS FURTHER ORDERED that the Commission's Consumer and Governmental Affairs Bureau, Reference Information Center, SHALL SEND a copy of this Further Notice of Proposed Rule Making, including the Initial Regulatory Flexibility Analysis, to the Chief Counsel for Advocacy of the Small Business Administration.

FEDERAL COMMUNICATIONS COMMISSION

Marlene H. Dortch  
Secretary

## APPENDIX A

## Initial Regulatory Flexibility Analysis

As required by the Regulatory Flexibility Act of 1980, as amended (RFA),<sup>1</sup> the Commission has prepared this present Initial Regulatory Flexibility Analysis (IRFA) of the possible significant economic impact on a substantial number of small entities by the policies and rules proposed in this Further Notice of Proposed Rule Making (FNPRM). Written public comments are requested on this IRFA. Comments must be identified as responses to the IRFA and must be filed by the deadlines for comments provided on the first page of this FNPRM. The Commission will send a copy of this FNPRM, including this IRFA, to the Chief Counsel for Advocacy of the Small Business Administration (SBA).<sup>2</sup> In addition, the FNPRM and IRFA (or summaries thereof) will be published in the Federal Register.<sup>3</sup>

**A. Need for, and Objectives of, the Proposed Rules**

This rule making proposal is initiated to obtain comments regarding proposed changes to the regulations for radio frequency devices that do not require a license to operate. We propose to expand the scope of the above proceeding to adopt technical rules for operation of specific types of low-power transmitters called level probing radar (LPR) devices, including tank level probing radars (TLPR), on an unlicensed basis under the provisions of Part 15 of the Commission's rules in the following frequency bands: 5.925-7.250 GHz, 24.05-29.00 GHz and 75-85 GHz. We propose to amend our Part 15 rules to revise the original proposed section 15.256 in the *Notice of Proposed Rule Making and Order (Notice and Order)* to permit the operation of LPR devices installed both outdoors in the open and inside storage tanks (TLPR) in the above frequency bands. We propose to treat LPR and TLPR devices the same with respect to emission limits and frequency bands of operation without any additional installation limitation. That is, a level-measuring radar that complies with our proposed rules will be able to be used in any application, whether outdoors in the open or inside any type of enclosure, e.g., steel or plastic. These proposals will also extend the operation of TLPR devices from the originally proposed 77-81 GHz band to the additional proposed frequency bands, at the new proposed main-beam emission limits. We propose emission limits for fundamental emissions depending on the LPR frequency bands of operation, as measured in the antenna main beam, based on the LPR Technical Standards adopted in Europe, to promote savings for manufacturers that operate in the global economy. We propose to require that all spurious/unwanted emission limits not exceed the general emission limits in Section 15.209 when measured in the main beam of the LPR antenna, as well as utilizing elevation and azimuth scans to determine the location at which the emissions are maximized. To further protect authorized services operating in the same and adjacent frequency bands, we also propose to adopt operational restrictions to require the LPR antenna to be dedicated or integrated as part of the transmitter and professionally installed in a downward position; to limit installations of LPR devices to fixed locations; and to prohibit hand-held applications of LPR and the marketing of LPR devices to consumers. We believe that our proposals herein would enable LPR devices that will provide better accuracy and reliability in target resolution to identify critical levels of materials such as fuel, water and sewer treated waste, and high-risk substances. The proposed amendments to our rules will permit these devices to operate effectively and reliably, reducing storage tank overflow and spilling and minimizing exposure of maintenance personnel in the case of high-risk materials, all without increasing the risk of interference to authorized services.

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<sup>1</sup> See 5 U.S.C. § 603. The RFA, see 5 U.S.C. §§ 601 - 612, has been amended by the Small Business Regulatory Enforcement Fairness Act of 1996 (SBREFA), Public Law No. 104-121, Title II, 110 Stat. 847 (1996).

<sup>2</sup> See 5 U.S.C. § 603(a).

<sup>3</sup> *Id.*

**B. Legal Basis.**

The proposed action is taken pursuant to Sections 1, 4(i), 302, 303(e), 303(f), 303(g), and 303(r) of the Communications Act of 1934, as amended, 47 U.S.C. Sections 151, 154(i), 302, 303(e), 303(f), 303(g), and 303(r).

**C. Description and Estimate of the Number of Small Entities to Which the Proposed Rules Will Apply.**

The RFA directs agencies to provide a description of and, where feasible, an estimate of the number of small entities that may be affected by the proposed rules, if adopted.<sup>4</sup> The RFA generally defines the term "small entity" as having the same meaning as the terms "small business," "small organization," and "small governmental jurisdiction."<sup>5</sup> In addition, the term "small business" has the same meaning as the term "small business concern" under the Small Business Act.<sup>6</sup> A small business concern is one which: (1) is independently owned and operated; (2) is not dominant in its field of operation; and (3) satisfies any additional criteria established by the SBA.<sup>7</sup>

*Radio and Television Broadcasting and Wireless Communications Equipment Manufacturing.* The Census Bureau defines this category as follows: "This industry comprises establishments primarily engaged in manufacturing radio and television broadcast and wireless communications equipment. Examples of products made by these establishments are: transmitting and receiving antennas, cable television equipment, GPS equipment, pagers, cellular phones, mobile communications equipment, and radio and television studio and broadcasting equipment."<sup>8</sup> The SBA has developed a small business size standard for Radio and Television Broadcasting and Wireless Communications Equipment Manufacturing, which is all such firms having 750 or fewer employees.<sup>9</sup> According to Census Bureau data for 2002, there were a total of 1,041 establishments in this category that operated for the entire

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<sup>4</sup> 5 U.S.C. § 603(b)(3).

<sup>5</sup> 5 U.S.C. § 601(6).

<sup>6</sup> 5 U.S.C. § 601(3) (incorporating by reference the definition of "small business concern" in 15 U.S.C. § 632). Pursuant to the RFA, the statutory definition of a small business applies "unless an agency, after consultation with the Office of Advocacy of the Small Business Administration and after opportunity for public comment, establishes one or more definitions of such term which are appropriate to the activities of the agency and publishes such definition(s) in the Federal Register." 5 U.S.C. § 601(3).

<sup>7</sup> Small Business Act, 15 U.S.C. § 632 (1996).

<sup>8</sup> U.S. Census Bureau, 2002 NAICS Definitions, "334220 Radio and Television Broadcasting and Wireless Communications Equipment Manufacturing"; <http://www.census.gov/epcd/naics02/def/NDEF334.HTM#N3342>.

<sup>9</sup> 13 C.F.R. § 121.201, NAICS code 334220.

year.<sup>10</sup> Of this total, 1,010 had fewer than 500 employees, and an additional 13 had between 500 and 999 employees.<sup>11</sup> Thus, under this size standard, the majority of firms can be considered small.

*Wireless Service Providers.* The SBA has developed a small business size standard for wireless firms within the two broad economic census categories of "Paging"<sup>12</sup> and "Cellular and Other Wireless Telecommunications."<sup>13</sup> Under both categories, the SBA deems a wireless business to be small if it has 1,500 or fewer employees. For the census category of Paging, Census Bureau data for 2002 show that there were 807 firms in this category that operated for the entire year.<sup>14</sup> Of this total, 804 firms had employment of 999 or fewer employees, and three firms had employment of 1,000 employees or more.<sup>15</sup> Thus, under this category and associated small business size standard, the majority of firms can be considered small. For the census category of Cellular and Other Wireless Telecommunications, Census Bureau data for 2002 show that there were 1,397 firms in this category that operated for the entire year.<sup>16</sup> Of this total, 1,378 firms had 999 or fewer employees, and 19 firms had 1,000 employees or more.<sup>17</sup> Thus, under this second category and size standard, the majority of firms can, again, be considered small.

We have proposed to reduce burdens wherever possible. Our proposals for new technical rules regarding LPR operation in the 5.925-7.250 GHz, 24.05-29.00 GHz, and 75-85 GHz would reduce burdens on small entities. LPR operation in these bands will increase the utilization of this spectrum by allowing a radio-frequency type of level-measuring technology to access the spectrum that is currently not used under the current technical rules for these types of industrial applications, resulting in more efficient use of these bands. Where possible we have made an effort to harmonize with international technical standards in Europe to promote cost savings for small manufacturers competing in the global economy. We will continue to examine further alternatives with the objectives of eliminating unnecessary regulations and minimizing significant economic impact on small entities. We seek comment on significant alternatives commenters believe we should adopt.

We do not expect that the rules proposed in this Further Notice of Proposed Rule Making will have a significant negative economic impact on small businesses.

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<sup>10</sup> U.S. Census Bureau, American FactFinder, 2002 Economic Census, Industry Series, Industry Statistics by Employment Size, NAICS code 334220 (released May 26, 2005); <http://factfinder.census.gov>. The number of "establishments" is a less helpful indicator of small business prevalence in this context than would be the number of "firms" or "companies," because the latter takes into account the concept of common ownership or control. Any single physical location for an entity is an establishment, even though that location may be owned by a different establishment. Thus, the numbers given may reflect inflated numbers of businesses in this category, including the numbers of small businesses. In this category, the Census Bureau breaks-out data for firms or companies only to give the total number of such entities for 2002, which was 929.

<sup>11</sup> *Id.* An additional 18 establishments had 1,000 or more employees.

<sup>12</sup> 13 C.F.R. § 121.201, NAICS code 517211.

<sup>13</sup> 13 C.F.R. § 121.201, NAICS code 517212.

<sup>14</sup> U.S. Census Bureau, 2002 Economic Census, Subject Series: Information, "Establishment and Firm Size (Including Legal Form of Organization)," Table 5, NAICS code 517211 (issued Nov. 2005).

<sup>15</sup> *Id.* The census data do not provide a more precise estimate of the number of firms that have 1,500 or fewer employees; the largest category provided is for firms with "1000 employees or more."

<sup>16</sup> U.S. Census Bureau, 2002 Economic Census, Subject Series: Information, "Establishment and Firm Size (Including Legal Form of Organization)," Table 5, NAICS code 517212 (issued Nov. 2005).

<sup>17</sup> *Id.* The census data do not provide a more precise estimate of the number of firms that have 1,500 or fewer employees; the largest category provided is for firms with "1,000 employees or more."

**D. Description of Projected Reporting, Recordkeeping, and Other Compliance Requirements**

Part 15 transmitters already are required to be authorized under the Commission's certification procedure as a prerequisite to marketing and importation. The reporting and recordkeeping requirements associated with these equipment authorizations would not be changed by the proposals contained in this FNPRM. The changes to the regulations would permit operation of unlicensed radar devices used in specific industrial applications at frequencies already used by other Part 15 devices and in a higher frequency band (75-85 GHz).

**E. Federal Rules that May Duplicate, Overlap or Conflict with the Proposed Rules.**

None.

APPENDIX B

Proposed Rule Changes

For the reasons discussed in the preamble, the Federal Communications Commission proposes to amend 47 C.F.R. Part 15 to read as follows:

Part 15 – RADIO FREQUENCY DEVICES

1. The authority citation for Part 15 continues to read as follows:

Authority: 47 U.S.C. 154, 202, 303, 304, 307 and 544A.

2. Section 15.3 is proposed to be amended by adding paragraph (hh) to read as follows:

Section 15.3 Definitions.

\* \* \* \* \*

(hh) Level Probing Radar (LPR): A short-range radar transmitter used in a wide range of applications to measure the amount of various substances, mostly liquids or granulates. LPR equipment may operate in open-air environments or inside an enclosure containing the substance being measured.

\* \* \* \* \*

3. Section 15.31 is proposed to be amended by revising paragraph (c) to read as follows:

Section 15.31 Measurement standards.

\* \* \* \* \*

(c) Except as otherwise indicated in § 15.256, for swept frequency equipment, measurements shall be made with the frequency sweep stopped at those frequencies chosen for the measurements to be reported.

\* \* \* \* \*

4. Section 15.35 is proposed to be amended by revising paragraph (b) to read as follows:

Section 15.35 Measurement detector functions and bandwidths.

\* \* \* \* \*

(b) Unless otherwise specified, on any frequency or frequencies above 1000 MHz, the radiated emission limits are based on the use of measurement instrumentation employing an average detector function. Unless otherwise specified, measurements above 1000 MHz shall be performed using a minimum resolution bandwidth of 1 MHz. When average radiated emission measurements are specified in this part, including average emission measurements below 1000 MHz, there also is a limit on the peak level of the radio frequency emissions. Unless otherwise specified, *see, e.g.*, §§ 15.250, 15.252, 15.255,

15.256 and 15.509-15.519 of this part, the limit on peak radio frequency emissions is 20 dB above the maximum permitted average emission limit applicable to the equipment under test. This peak limit applies to the total peak emission level radiated by the device, *e.g.*, the total peak power level. Note that the use of a pulse desensitization correction factor may be needed to determine the total peak emission level. The instruction manual or application note for the measurement instrument should be consulted for determining pulse desensitization factors, as necessary.

\* \* \* \* \*

5. Section 15.205 is proposed to be amended by revising paragraph (d)(4) to read as follows:

Section 15.205 Restricted bands of operation.

\* \* \* \* \*

(d) \* \* \*

\* \* \* \* \*

(4) Any equipment operated under the provisions of § 15.253, § 15.255, § 15.256 in the frequency band 75-85 GHz, or § 15.257 of this part.

\* \* \* \* \*

6. Section 15.256 is proposed to be added to read as follows:

Section 15.256 Operation of level probing radars within the bands 5.925-7.250 GHz, 24.05-29.00 GHz, and 75-85 GHz.

- (a) Operation under this section is limited to level probing radar (LPR) devices.
- (b) LPR devices operating under the provisions of this section shall utilize a dedicated or integrated transmit antenna, and the system shall be professionally installed and maintained to ensure a downward orientation of the transmit antenna.
- (c) LPR devices operating under the provisions of this section shall be installed only at fixed locations.
- (d) Hand-held applications and marketing to residential consumers are prohibited.
- (e) The fundamental bandwidth of an LPR emission is defined as the width of the signal between two points, one below and one above the center frequency, outside of which all emissions are attenuated by at least 10 dB relative to the maximum transmitter output power when measured in an equivalent resolution bandwidth.
  - (1) The minimum fundamental emission bandwidth shall be 50 MHz for LPR operation under the provisions of this section.
  - (2) LPR devices operating under this section must confine their fundamental emission bandwidth within the 5.925-7.250 GHz, 24.05-29.00 GHz, and 75-85 GHz bands under all conditions of operation.
- (f) Fundamental Emissions Limits

- (1) All emission limits provided in this section are expressed in terms of Equivalent Isotropic Radiated Power (EIRP).
- (2) The EIRP level is to be determined from the maximum measured power within a specified bandwidth.
  - (i) The EIRP in 1 MHz is computed from the maximum power level measured within any 1-MHz bandwidth using a power averaging detector;
  - (ii) The EIRP in 50 MHz is computed from the maximum power level measured with a peak detector in a 50-MHz bandwidth centered on the frequency at which the maximum average power level is realized.
- (3) The EIRP limits for LPR operations in the bands authorized by this rule section are provided in the following table:

Frequency Band of Operation (GHz)	EIRP Limit in 1 MHz (dBm)	EIRP Limit in 50 MHz (dBm)
5.925-7.250	-33	7
24.05-29.00	-14	26
75-85	-3	34

- (g) Unwanted Emissions Limits
  - (1) All emission limits provided in this section are expressed in terms of Equivalent Isotropic Radiated Power (EIRP) and are computed based on the maximum average power level measured within any 1-MHz bandwidth.
  - (2) Unwanted emission limits applicable to LPR devices shall not exceed the general emission limits in Section 15.209.
- (h) Antenna Beamwidth
  - (1) LPR devices operating under the provisions of this section within the 5.925-7.250 GHz and 24.05-29.00 GHz bands must use an antenna with a maximum half-power beamwidth of 12 degrees.
  - (2) LPR devices operating under the provisions of this section within the 75-85 GHz band must use an antenna with a maximum half-power beamwidth of 8 degrees.
- (i) Antenna Side Lobe Gain
  - (1) LPR devices operating under the provisions of this section must limit the side lobe antenna gain to -10 dB<sub>i</sub> for off-axis angles from the main beam of greater than 60 degrees.
- (j) Measurement Procedures
  - (1) Radiated measurements of the fundamental emission bandwidth and power shall be made with maximum main beam coupling between the LPR and test antennas (boresight).
  - (2) Measurements of the unwanted emissions radiating from an LPR shall be made utilizing elevation and azimuth scans to determine the location at which the emissions are maximized.
  - (3) All emissions at and below 960 MHz are based on measurements employing a CISPR quasi-peak detector.
  - (4) The fundamental emission bandwidth measurement shall be made using a peak detector with a resolution bandwidth of 1 MHz and a video bandwidth of at least 3 MHz.

- (5) The provisions in Section 15.35(b) and (c) of this part that require emissions to be averaged over a 100 millisecond period and that limits the peak power to 20 dB above the average limit do not apply to devices operating under this section.
- (6) Compliance measurements of frequency-agile LPR devices shall be performed with any related frequency sweep, step, or hop function activated.
- (7) Compliance measurements shall be made in accordance with the specific procedures published or otherwise authorized by the Commission.